Short Communications

An improved cover determination method using the Plant Number Scale classes

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Received 29 October 1997; revised 14 May 1998

A method for determining plant cover using crown diameters and plant count is described.

Keywords: canopy cover, crown spread, density, computer program, vegetation.

The Plant Number Scale (Westfall & Panagos 1988; Westfall *et al.* 1996) method of determining plant canopy cover is a cover sampling method based on mean crown diameter and mean crown to crown spacing, derived from Edwards (1983) crown to gap ratios. The mean crown diameter determines cover-sampling transect length (Table 1) while the transect width is based on $^4/_5$ ths of the mean crown to crown gap. The number of individuals are counted within the transect and the percentage cover is read off a scale (Table 2), according to the count. Thus, both plant spacing and aerial size are taken into account in the cover sample. Scale increments are whole plants, resulting in a 33 class scale (Table 2).

Percentage canopy cover, the derived variable, and mean crown diameter, the measured variable, enable plant density to be calculated as follows:

$$A = \frac{C \times 10\,000}{100}$$

where,
A = area (m^2), covered by canopy in 1 ha
C = projected canopy cover of plant species, as a percentage, and

$$D = \frac{A}{\pi r^2}$$

where,
D = density, in terms of individuals per hectare
r = crown radius, being half mean crown diameter (m)

From this it can be concluded that given any two of the variables cover, mean crown diameter and density the third variable can be calculated.

The advantages of the Plant Number Scale include increased precision compared with other visual scale estimation techniques and skill development in visually estimating cover. The disadvantages include reduced precision because of the classes used for crown diameters as well as sometimes insufficient variation being included within, especially, shorter transects. A further disadvantage is the difficulty in determining mean crown to crown gaps for plants with varied spacing. Spacing can vary considerably for plants with a given cover and density in terms of individuals per hectare.

The aim of this paper is, therefore, to improve the precision of, and simplify cover determination by describing a method for determining canopy cover, based on plant count and mean crown diameter.

The procedure is to determine the mean canopy diameter of a group of plants under consideration and to count the number of these plants within an area related to the size of the mean canopy diameter. This area is taken as the circular area in which a single plant would have 0.1% cover. Thus, the variation likely to be encountered with higher cover values is included.

Table 1 Cover sampling transect lengths determined from mean crown diameters

Crown diameter (m)	Transect length (m)
0.001–0.010	0.15
0.011–0.020	0.45
0.021–0.030	0.75
0.031–0.050	1.20
0.051–0.080	1.95
0.081–0.130	3.15
0.131–0.210	5.10
0.211–0.340	8.25
0.341–0.550	13.35
0.551–0.890	21.60
0.891–1.440	34.95
1.441–2.330	56.55
2.331–3.770	91.50
3.771–6.100	148.05
6.101–9.870	239.55

A count of 32 would result for plants with about 100% canopy cover. A larger area would mean an impracticable number of plants to count. For plants with a high cover and consequently reduced variation in spacing only a segment of the circle need be used for the count, which is then multiplied by the number of segments in the circle.

Projected percentage canopy cover (C) can then be calculated:

$$C = \frac{\text{Mean canopy area} \times \text{Plant count}^2 \times 90.07}{\text{Area of sampling circle}}$$

Canopy cover determination can consist, therefore, of measuring the crown diameters of individuals of a plant species and counting the number of plants in a given area. These steps have been included in a program DATCAP written for a PSION LZ64 for field data capture. The program indicates the radius of the area needed for the plant count on entering one or more crown diameters. On entering the plant count the program then indicates the cover percentage obtained. Percentage cover can then assigned to a Plant Number Scale class as shown in Table 2. This is a far simpler procedure than that used for the Plant Number Scale using transects.

Acocks (1953, 1975, 1988) derived density from mean plant spacing according to a twenty class scale based on centre to centre spacing and where the space occupied by each plant is taken as square. This can be calculated as follows:

$$D = \frac{10\,000}{S^2}$$

where,
S = mean centre to centre spacing (m), and

$$S = \sqrt{\frac{10000}{D}}$$

However, where the space occupied by each plant is taken as circular then:

$$D = \frac{10\,000}{\pi(S/2)^2}$$

and

$$S = 2\sqrt{\frac{10000}{\pi D}}$$

Table 2 The Plant Number Scale showing plant count, cover symbols, percentage cover, class limits and class intervals

Count	Symbol	% Cover	Class limits	Class interval
0	+	0.01	> 0.000–0.049	0.049
1	1	0.10	0.050–0.249	0.199
2	2	0.40	0.250–0.654	0.404
3	3	0.91	0.655–1.259	0.604
4	4	1.61	1.260–2.064	0.804
5	5	2.52	2.065–3.074	1.009
6	6	3.63	3.075–4.284	1.209
7	7	4.94	4.285–5.694	1.409
8	8	6.45	5.695–7.314	1.619
9	9	8.16	7.315–9.129	1.814
10	A	10.08	9.130–11.139	2.009
11	B	12.19	11.140–13.354	2.214
12	C	14.51	13.355–15.769	2.414
13	D	17.03	15.770–18.389	2.619
14	E	19.75	18.390–21.214	2.824
15	F	22.67	21.215–24.239	3.024
16	G	25.80	24.240–27.459	3.219
17	H	29.12	27.460–30.884	3.425
18	I	32.65	30.885–34.514	3.629
19	J	36.38	34.515–38.344	3.829
20	K	40.31	38.345–42.374	4.029
21	L	44.44	42.375–46.609	4.234
22	M	48.78	46.610–51.044	4.434
23	N	53.31	51.045–55.679	4.634
24	O	58.05	55.680–60.519	4.839
25	P	62.99	60.520–65.559	5.039
26	Q	68.13	65.560–70.799	5.239
27	R	73.47	70.800–76.284	5.484
28	S	79.10	76.285–81.929	5.644
29	T	84.75	81.930–87.729	5.799
30	U	90.70	87.730–93.774	6.044
31	V	96.85	93.775–98.424	4.649
32	W	100.00	> 98.425	1.575

With plant spacing known, as calculated according to Acocks's formula, data can be converted to Acocks's density classes for direct comparison.

The method described provides a simple means of determining both canopy cover and density as actual values or as Plant Number Scale classes, as well as indicating plant size in terms of mean crown spread. Mean plant spacing, which is not easily measurable, can be derived from density. The method also includes more variation than is included with the Plant Number Scale method and is, therefore, suitable for plants with low canopy cover. It is also suitable for comparing Acocks' density classes over time.

Acknowledgements

The support of the ARC for this work is gratefully acknowledged as well as the encouragement of the the Director of the Range and Forage Institute, Dr Amie Aucamp.

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Effect of a seaweed concentrate on acclimatization of *in vitro* grown plantlets of *Kniphofia pauciflora* and *Scilla krausii*

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Received 26 March 1998; revised 29 May 1998

Kelpak, a seaweed concentrate prepared from *Ecklonia maxima* (Osbeck) Papenfuss, applied as a soil drench following the planting out of *in vitro* grown plantlets of *Scilla kraussii* Bak. and *Kniphofia pauciflora* Bak. significantly increased root growth and promoted plantlet establishment. It is suggested that seaweed concentrate can be used successfully and economically to aid in the acclimatization of *in vitro* grown plantlets.

Keywords: Acclimatization, Kelpak, *Kniphofia pauciflora*, *Scilla kraussii*.

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An important stage in tissue culture is the hardening off, or acclimatizing of the *in vitro* grown plantlets to the conditions outside the culture flask. A loss at this late stage has serious financial implications, especially when one considers all the resources that are put into producing the *in vitro* plantlets.

Many reports indicate that seaweed products improve plant